ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of:	)	
	)	
Revision of the Commission's	)	CC Docket No. 94-102
Rules To Ensure Compatibility	)	
With Enhanced 911 Emergency	)	
Calling Systems	)	

COMMENTS OF AT&T CORP.

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SUMMARY

AT&T supports making multi-line telephone systems ("MLTS") and wireless services as compatible with enhanced 911 ("E911") systems as is technically and economically feasible. In addition, AT&T agrees with the Commission that existing shortcomings in the provision of location information and other critical components of compatibility merit immediate attention by the industry. Indeed, AT&T continues to work closely with public safety organizations to prioritize needs and address technical issues associated with E911.

At the same time, however, AT&T believes that the approach to compatibility taken in the Notice should be fundamentally re-examined. With respect to MLTS issues, the Commission's proposals should be substantially clarified and restructured. With respect to wireless issues, AT&T disagrees that regulatory design specifications and performance deadlines are necessary or appropriate. These concerns are summarized below and discussed in detail herein.

1. MLTS Issues

The Commission should revise and supplement the definitions associated with its 911/MLTS rules in several respects. In addition, the Commission should require that operators of MLTS outpulse to the Local Exchange Carrier ("LEC") a "Caller's Emergency Services Identification"

("CESID"), which would be assigned by the LEC and could be shared by all telephones in the same emergency response location. (In the case of MLTS serving wireless systems, the location of the antenna would be identified with a CESID.) The rules also should dictate that the LEC be responsible for maintaining a data base of locations for each CESID and providing selective routing. Outpulsing of the CESID could be accomplished either through MLTS switches with this capability or through adjunct equipment, but the Commission should not impose a requirement that PBXs or similar equipment be capable of outpulsing CESIDs.

AT&T has the following comments with respect to other major technical matters raised in the Notice:

- MLTS equipment manufactured three years after the effective date of the rules should be capable of transmitting 911 calls not preceded by a 9 or other digit. However, the Commission should not require warning labels for non-complaint equipment, because doing so would create confusion.

- MLTS equipment should be capable of notifying an on-premise attendant (if any) that a 911 call has been made by a particular calling station.

- The rules should specify responsibilities for maintaining the location data base and should mandate compliance with the National Emergency Numbering Association ("NENA") standard for transmission of information from the data base to the Public Safety Answering Point ("PSAP").

- Requirements regarding the capabilities of dispersed private telephone systems should not have to be met by any particular piece of equipment, as long as they are met by the system as a whole.

- The technical standards should not specify MF signalling, because doing so would deny

manufacturers the opportunity to take advantage of new signalling technology. In addition, verification by trained personnel is appropriate for additions to the data base, but burdensome for deletions.

Finally, AT&T suggests that the new rules be placed in a new Part of the Commission's Rules. The Part 68 model is inappropriate because most compliance matters do not depend on the design of particular items of MLTS equipment.

2. Wireless Service Issues

The Notice proposes to require that various aspects of compatibility between wireless services and 911 systems be implemented by specified deadlines. AT&T respectfully submits that this approach both fails to appreciate the seriousness of the technical challenges to compatibility and ignores the process that already has been set in motion to overcome these hurdles.

AT&T participated actively in a Joint Expert Meeting ("JEM") involving representatives of the wireless industry, manufacturers, and public safety organizations, which culminated in the release of two JEM Reports regarding wireless/E911 issues. Those reports, which represent a consensus position of all affected interests, prioritize the needs of PSAP providers, form the basis for specification of performance standards, and identify possible technologies for achieving various elements of compatibility. They advocate an evolutionary approach to compatibility that is far

preferable to the arbitrary deadlines contained in the Notice. Accordingly, AT&T urges the Commission to refrain from specifying elements of compatibility or imposing compliance cut-off dates. Rather, it should monitor the industry's progress and facilitate the development of standards and technology by the private sector. In particular, instead of establishing three stages for the provision of increasingly precise location information, the Commission should direct the industry to provide calling number identification as soon as possible, as an interim step toward full compatibility.

With respect to other issues raised in the Notice, AT&T comments as follows:

- The compatibility requirement should apply to new and existing real-time voice CMRS with the exception of air-to-ground service.
- Any service-initialized handset should be allowed to make a 911 call without user validation one year after the adoption of rules, but those rules must acknowledge the operating characteristics of mobile services, including the possibility of weak radio coverage and insufficient battery power.
- The Commission should clarify that mobile subscribers can reach 911 by dialing 9-1-1 plus the SEND key, and should not require retro-fitting of any non-compliant handsets in order to allow 911 calls to be made by locked phones.
- The Commission should direct the industry to examine the technical issues raised by call prioritization and report back by a date certain.
- Provision of a call-back number represents the most logical and achievable interim approach to compatibility, and technical challenges likely can be overcome within three years.

- The Commission should rely on the JEM process to determine what information should be provided to the PSAP and how that information should be transmitted, given differing implementation of signalling protocols in landline and wireless networks.

- Compatibility with TTY devices can be met from the standpoint of the wireless service provider, but will depend on the LEC and PSAP being able to accept the transmitted data.

- The Commission should not require labelling of handsets because labels can be confusing and deter subscribers from calling 911, and will not reflect upgrades to system capabilities. Rather, customer education should proceed through manuals, service contracts, and bill inserts.

- Wireless carriers should enjoy the same immunity with respect to transmission of 911 calls that applies to landline carriers.

- The Commission should preempt state regulation of wireless/E911 compatibility in order to assure nationwide deployment of consistent technology. It also should preempt state or local zoning restrictions that would affect the deployment of ALI-related technology at cell sites.

- The Commission should initiate a proceeding to develop a funding mechanism for deploying compatibility-related technology.

Taking these steps will expedite the availability of efficient and effective E911 capabilities to wireless subscribers.

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COMMENTS

AT&T Corp. ("AT&T") respectfully submits the following comments in response to the Commission's Notice of Proposed Rulemaking ("Notice"), FCC 94-237, released October 19, 1994.

As a leading provider of multi-line telecommunications systems ("MLTS") and wireless services, AT&T strongly supports making 911 services as responsive to emergencies as is technically and economically feasible. AT&T also believes that the Notice accurately identifies shortcomings in the location information presently supplied to Public Safety Answering Points ("PSAPs") on calls from stations behind an MLTS and wireless telephones. Consequently, AT&T commends the Commission for focusing attention on the technical, economic, and policy issues engendered by E911 compatibility.

At the same time, however, AT&T is concerned that the approach in the Notice both underestimates the sheer quantity of work that is needed to maximize compatibility and the dedication with which AT&T and other affected parties already are seeking to overcome the myriad of challenges. Compatibility cannot be

compelled by a schedule established by regulatory order. Rather, it will require the continuing collaboration of manufacturers, service providers, end users, and PSAP providers within a policy framework that permits all parties to develop and test standards and technology in a flexible, orderly manner.

Against this background, AT&T harbors considerable reservations regarding the specific proposals for both MLTS and wireless service compatibility. In both cases, the rules should strive to clarify the obligations of all affected parties -- not just manufacturers and wireless service providers -- rather than dictating design requirements and establishing arbitrary, and in many cases unattainable, compliance deadlines. To this end, Part I of these Comments suggests clarifications and modifications to the proposed rules regarding MLTS/911 compatibility. Part II recommends both changes to the proposals, and in some cases, an entirely new approach to the particularly nettlesome issues raised by wireless/E911 compatibility.

AT&T looks forward to continued cooperation with the Commission, other service providers and manufacturers, end users, and emergency response organizations in expediting achievement of compatibility. It respectfully submits that adoption of rules consistent with the recommendations set forth below will enhance the effectiveness and efficiency of the process for reaching that critical objective.

I. THE COMMISSION SHOULD ISSUE NEW RULES APPLICABLE TO THE RELATIONSHIP BETWEEN MULTI-LINE TELEPHONE SYSTEMS AND ENHANCED 911 CALLING AS DISCUSSED IN THESE COMMENTS.

A. Introduction

The Notice proposes to adopt rules improving the ability of enhanced 911 service to provide information permitting a response to the precise location of the emergency. The Commission chose to make certain of these improvements regarding MLTS, such as PBX or key telephone equipment, by proposed changes to the equipment registration rules in Part 68.[1] The Notice discusses related subjects but contains no rule text.

AT&T disagrees with the Commission's approach of addressing enhanced 911 issues by changing Part 68.[2] Many of the needed improvements do not require changes in equipment. In fact, some of the Commission's own proposals, cast as amendments to Part 68, such as the required training and qualifications of the installation supervisor (proposed §68.228(c)) and the grade of service, and thus the number of trunks which the customer must have (proposed §68.228(d)), have nothing to do with the technical characteristics of terminal equipment that can be connected to

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[1] 47 C.F.R. Part 68.

[2] The Notice notes that this aspect of its proposal responds to a Petition for Rulemaking by Adcomm Engineering Company ("Adcomm") seeking amendments to Part 68. Adcomm itself, in its Reply Comments regarding that Petition, explained that Part 68 "was chosen as a base for pursuit of a broader resolution to the problem," which has database management and numbering aspects as well as equipment architecture aspects. Those latter issues, and others, are addressed in the Notice, confirming that changing Part 68 is not the way to remedy 911 problems.

the network. Moreover, other matters as to which the Commission asks for comment and for rule language are also inappropriate for inclusion in that Part. One example is the responsibilities of various participants in the 911 process, such as local exchange carriers and public safety agencies. AT&T therefore proposes that the Commission create a new Rule Part on MLTS and enhanced 911 calling. The relevant issues are discussed below.

B. Definitions.

AT&T suggests that the new rules clearly define what Enhanced 911[3] (AT&T suggests adding the word "Calling") is and what must be compatible with it. The definitions in the Commission's proposed rules are, however, insufficient and inaccurate.

The Commission's proposed definition of Enhanced 911 is expressed in terms of location information but fails to encompass the issue of routing calls to the appropriate PSAP. Therefore, AT&T suggests that Enhanced 911 Calling is:

> "a telephone network capability that provides both Selective Routing of 911 calls and the display of call location information on the video display terminal of the safety agent who answers the call."

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[3] The proposed rules sometimes use the form 9-1-1 and other times 911. AT&T suggests uniformity in this regard and these comments use the 911 form.

AT&T's proposed definition of Selective Routing is:

> "the ability of the telephone network to route a 911 call to the Public Safety Answering Point serving the location from which a 911 call originates."

In turn, a suggested definition of Public Safety Answering Point is:

> "an agency responsible for answering 911 calls originating from a particular geographic area and dispatching emergency response personnel."

Some rules on compatibility with Enhanced 911 Calling, such as those embodying the Commission's proposals on qualifications of the installation supervisor, apply to all multi-line equipment.[4] A definition of Multi-Line Telecommunications System that recognizes the scope of the rules is as follows:

> "a customer-premises telephone switching system, such as a Private Branch Exchange or Key Telephone System that serves more than one telephone line."

On the other hand, some rules, such as the requirement to provide location information in addition to the calling telephone number, apply only to "dispersed private telephone systems." These systems have calling stations spread over an amount of space, either within a building or even among multiple buildings, too broad to permit the actual site of the emergency to be readily reached without good location information. The Commission's proposed definition addresses this concept in terms of carrying emergency calls from "more than one emergency

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[4] When a 911 call is dialed from a single line telephone, no special rules are needed because that number is sufficient to provide location information.

response location." The Commission's proposed definition of "emergency response location," however, is too restrictive. In many cases, multiple calling stations may be close to, and observable by, each other, such as an office floor with work stations surrounded by a few private offices. Therefore, the term "emergency response location" should not be defined in terms of each calling station. Rather, AT&T suggests the following definition:

> "an area of a size and configuration permitting an emergency response team dispatched to that area to locate the caller quickly."

C. Caller Location

To serve the public interest and achieve the goals of this proceeding, AT&T proposes that the Commission restate its goal for ensuring compatibility of PBX equipment with Enhanced 911 Calling.[5] Rather than merely ensuring that "PBX equipment does not hinder delivery of emergency services by impeding the transmission of adequate location information" (emphasis added), the Commission should affirmatively require that "operators"[6] of MLTS ensure that those systems outpulse to the LEC a number, which AT&T proposes to denominate the CESID.

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[5] See Notice at ¶ 21.

[6] AT&T chose the term "operator" instead of "owner" to account for situations in which, technically, the owner is an entity such as the vendor or a financial institution remote from actual installation and operation of the system.

The CESID would be a seven to ten digit number assigned to a telephone[7] (not necessarily a ten-digit number as stated in the Commission's proposed § 68.228(a)(2)). The CESID, which the LEC should be required to assign, may be the directory number of the calling telephone, the billing number of the calling telephone or a pseudo-telephone number of some sort.[8] The same CESID can be shared by a number of telephones so long as they are in the same emergency response location. Having assigned the CESIDs, the LEC also would be responsible for maintaining a data base of locations for each CESID and providing Selective Routing.[9]

The Notice recognizes that the Commission's rules must provide sufficient flexibility to foster development of alternative approaches and must not unduly burden manufacturers and operators of MLTS equipment.[10] To fulfill these objectives, AT&T urges that the Commission not require that any particular piece of equipment outpulse the CESID. The very same item of equipment may often be used in private telephone systems that

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[7] In these comments AT&T uses the term "telephone" to include an antenna used in a building to pick up calls from wireless terminals and transmit those calls to the MLTS for delivery to the telephone network.

[8] The Commission's proposed rule uses the term Station Number Identification but provides no information as to what this number could be, beyond having ten digits.

[9] The Commission may wish to consider appropriate rules regarding the LEC responsibility when it offers a service under which operators of MLTS' themselves maintain the database.

[10] Notice at ¶ 21.

are not dispersed, so that the main telephone number of the PBX provides location information sufficient to permit emergency response personnel rapidly to locate the actual site of the emergency. Therefore, requiring all equipment to outpulse CESIDs will impose costs on some users without corresponding benefit. Where the system is dispersed, so that the requirement to outpulse CESIDs is appropriate, permitting such outpulsing to be achieved through an adjunct device rather than by the PBX itself offers manufacturers and operators more choices and fosters a greater range of technical solutions.

The proper role for the Commission is to mandate the end result: outpulsing CESIDs from dispersed systems. The marketplace, rather than the Commission, can best decide the acceptability of different approaches to achieving this result, including the extent to which adjunct devices meet the needs of the operators, and the roles of vendors versus operators of PBX systems in assuring that the requisite capability exists.[11]

Paragraph 21 also asks for comment on any particular difficulties in applying the rule to college campuses, hospitals, military installations or wireless PBXs. The first three of those locations, and particularly military bases, might require the emergency response personnel to go to a particular entrance to gain admittance to the facility. The same thing may

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[11] It would be reasonable for the Commission to impose on manufacturers a requirement that their instructions inform the user whether adjunct equipment is required and, if so, information regarding such adjuncts and how to connect them.

be true of an office building after hours. Thus, there does not appear to be any problem peculiar to these locations.

The compatibility of wireless PBX systems with E911 systems presents the same challenges that confront other wireless services that are discussed in Part II of these comments. In recognition of these challenges, AT&T proposes that, to the extent technically feasible, the FCC treat the in-building base station antennas through which wireless PBX terminals access the MLTS as if they were wired telephones. Thus, a CESID must be assigned to each wireless base station antenna serving multiple wireless handsets which, as a group, are designated as a single emergency response location, and the MLTS should be required to outpulse the CESID of the base station antenna transmitting a call to 911 from a wireless handset. It is, of course, true that the actual site of the emergency may not be at or near that base station antenna for a number of reasons, such as that the caller is reporting an emergency observed from some distance. But the same thing can be true of a call from a wired telephone. Also, callers from both wired and wireless telephones, whether they are experiencing the emergency or observing it, may have departed the vicinity of the telephone or antenna from which they called 911.[12]

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[12] Location information regarding the antenna picking up a 911 call from a wireless station should be sufficient in the in-building environment. In contrast, requiring updated information regarding the location of the caller as he or she moves around the building would raise extremely difficult technical issues.

It also is true that there may be no call-back capability to the wireless telephone causing the outpulsed CESID of the base station antenna transmitting the call. But even in the wired telephone environment, the CESID may not be callable for various reasons, such as that it is not a dialable number at all, or is not dialable from outside the MLTS. Wired and wireless telephones are also treated the same way whenever the main telephone number of the MLTS is identified at the PSAP as the call back number. Thus, in AT&T's view, subject to the limitations described above, the Commission can craft rules applicable to MLTS' serving wireless stations as well as wired stations.

D. 911 Availability

The Notice tentatively concludes that callers from telephones behind PBXs should be able to reach emergency services by dialing 911 without dialing any additional digits.[13] Thus, requiring dialing 9-911 or *8-911 or similar configuration would be prohibited. Although regular users would rarely have difficulty no matter what dialing sequence were required, it is true that infrequent users, such as guests in hotel rooms or visitors to building lobbies, could experience problems. Therefore, AT&T agrees that the Commission should require MLTS equipment installed after some date to have the capability to

[13] Notice at ¶ 22.

reach emergency services by dialing 911.[14] AT&T suggests that this requirement could be implemented three years after the effective date of the rules.

AT&T disagrees, however, with the proposal that PBX equipment domestically manufactured or imported prior to that implementation date be labeled with a warning.[15] Because there is a huge universe of in-place equipment that is not (and should not be) required to have the new capability or a warning label, the absence of such a label does not distinguish between old equipment that does not permit access via 911 and new equipment that does. Thus, the proposed labeling scheme creates confusion rather than providing useful information.

E. Attendant Notification

AT&T agrees with the proposal that new PBX systems have the capability to alert an attendant, if one is present, that 911 has been dialed and to provide calling station identification.[16] Under this proposal, the attendant, whether he or she is on post or walking rounds, gets a record of the 911 call. The attendant can then provide valuable help to the emergency service personnel in locating the site, particularly in large facilities. The Commission should make it clear that the

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[14] This does not mean that also being able to do so by dialing some other sequence would be barred. The Commission's proposed § 68.320(c) is correct in this regard.

[15] Id.

[16] Id. at ¶ 23.

attendant notification requirement does not mean that the attendant must be bridged on to 911 calls, particularly when state or local regulations prohibit it. Thus, any conflict between the attendant notification requirement and state or local law will be avoided.

F. ALI Data Base Maintenance and Information Protocol Standards

The Notice correctly recognizes that timely and accurate data base maintenance is an essential element of Enhanced 911 Calling, but notes that several parties regard it as a separate issue from equipment compatibility.[17] Whether those issues are separate or not is, however, beside the point. AT&T suggests that the Commission's rules specify roles and responsibilities for timely and accurate data base maintenance in order to achieve the goals of this proceeding.[18]

Rules insuring accurate transmission of information from the MLTS to the LEC, such as those contained in the Commission's proposed rules, address part of the problem. Responsibilities regarding transmission of caller location information to the PSAP, whether by the LEC or the operator of the MLTS system, must be fulfilled if the benefits of Enhanced 911 Calling are to be available in practice.

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[17] Id. at ¶ 24.

[18] Because it is the database, not the MLTS, which provides to the PSAP the caller's identification, location and call back number, proposed § 68.320(f) is wrong in making this an equipment requirement.

Specifying a uniform standard for the format governing display of information on the PSAP attendant's screen is essential to avoid confusion, as the Notice points out (¶ 27). Moreover, uniformity will make it easier to implement new applications and improvements in technology. AT&T agrees with those who support mandatory compliance with the NENA standard in this regard. This is not, however, a requirement for MLTS equipment, but rather is a requirement applicable between the data base and the PSAP. The need to address these data base-related topics in a complete rule further demonstrates that a new rule part is needed, rather than attempting to force unrelated concepts into the Part 68 structure.

G. Implementation Schedule

As discussed in these comments, requirements regarding the capabilities of dispersed private telephone systems should not have to be met by any particular piece of equipment, so long as the system meets them. Therefore, the usual Part 68 structure of a date by which manufacture and importation of non-complying equipment is prohibited and a later date by which installation of such equipment is barred is inapposite.

Also, the required compliance date for dispersed private telephone systems should tie-in to the compliance date for data base and video display matters. From the equipment perspective, three years from the effective date of the new rules seems

reasonable.[19] LECs and public safety agencies have the relevant expertise on the compliance schedule appropriate for them.

H. Additional Comments on the Commission's Proposed Rules.

The new rules should avoid several errors and inadequacies in the text of the proposed rules. The definition of "Enhanced 9-1-1 emergency services trunk" is incorrect in that it could be coaxial cable or fiber in addition to 2-wire or 4-wire. Moreover, the phrase "access to" Enhanced 9-1-1 service in that definition is not as clear as AT&T's proposed alternative of "supports Enhanced 911 Calling."

Tying into AT&T's point that the new rules should govern responsibilities of all participants in the process, including public safety agencies, proposed § 68.106(f) on information the customer must supply to the LEC (including the number of trunk connections required) ignores the important role of such agencies in determining that information.

The Commission's approach (proposed § 68.228) of mandating that proper functioning of equipment be verified by installation supervisors with specified qualifications is sensible. It is appropriate to insist on those qualifications of operation when

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[19] This recognizes that location information on the antennas picking up a 911 call from a wireless station should be sufficient. If, however, display of location information of the calling station is required as the caller moves around the building, the implementation schedule should be the same as that for the same capacity regarding wireless services. See infra Part II.C.4. The reason is that the technical problems are the same in both instances.

there are additions to the data base, but it seems burdensome and unnecessary to do so in the case of deletions.

The technical standards in proposed § 68.320(b) should not specify MF signalling because that would deny manufacturers the opportunity to take advantage of new signalling technology. The requirement (proposed § 68.320(d)) that the operator order enough trunks to provide an availability of P = 0.01 appears excessive, given the low usage of these trunks. The operator, LEC, and PSAP provider should have the ability to agree on the needed facilities.

II. THE COMMISSION SHOULD NOT ESTABLISH DESIGN CRITERIA OR COMPATIBILITY DEADLINES FOR WIRELESS/E911 COMPATIBILITY, BUT RATHER SHOULD ALLOW INDUSTRY BODIES TO DEVELOP AND TEST STANDARDS AND TECHNOLOGY SUBJECT TO COMMISSION OVERSIGHT.

A. Introduction

AT&T strongly endorses the concept of full compatibility between wireless services and E911 systems. At the same time, however, AT&T respectfully differs both with the Commission's assessment that the mobile industry would not voluntarily promote compatibility of wireless services and E911 systems,[20] and its proposal to require various aspects of compatibility to be implemented by fixed deadlines. As discussed herein, the industry has in fact been working hard to overcome the tremendous technical challenges to compatibility. Because

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[20] Notice at ¶ 34 n.38.

considerable obstacles remain, however, adopting arbitrary compliance deadlines would be premature and counter-productive.

AT&T shares the Commission's ultimate goal of ensuring "that, over time, mobile radio service users on the public switched telephone network have the same level of access to 911 emergency services as wireline callers."[21] To this end, AT&T (through its wireless service subsidiary, McCaw Cellular Communications) has actively sought to provide emergency service contact capabilities to its wireless customers. For example, AT&T routinely notifies the 911 community in its markets regarding the turn-on date for cell sites in order to provide for proper routing of 911 calls. Starting this month, AT&T's cellular systems will provide automatic number identification ("ANI") on a trial basis in Washington state. In Oklahoma City, AT&T has been working with the Association of Central Oklahoma Governments on a method of identifying 911 callers by base station. And, in Florida, AT&T offers a service called *FHP (Florida Highway Patrol) for handling minor emergencies and incidents that are not sufficiently significant for a 911 call. In addition, AT&T has been integrally involved in industry efforts to promote compatibility and develop automatic location identification ("ALI") technology. It is an active member of NENA and the Associated Public Safety Communications Officials-International ("APCO") on the national and state levels, sitting

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[21] Id. at ¶ 37.

on APCO's Project 31 committee (which is examining wireless 911 issues) and collaborating with the Washington state APCO chapter on the aforementioned experimental ANI project.

The wireless industry's commitment to E911 compatibility is reflected in the work of the two JEM Reports, which AT&T fully supports. These reports represent the consensus of wireless service providers, manufacturers, and the E911 community regarding the critical elements of compatibility and define a reasonable evolutionary path toward achievement of this objective. They also demonstrate that the approach to compatibility taken in the Notice, which proposes to mandate design requirements rather than performance standards and to set arbitrary deadlines rather allow orderly progress toward the ultimate goal of compatibility, does not comport with technical realities.

AT&T respectfully submits that the issues surrounding compatibility are not as clear-cut as the Notice assumes. Equivalent access to E911 for wireless subscribers will depend on overcoming several substantial technical challenges stemming from the unique characteristics of mobile services:

First, the achievement of E911 compatibility for wireless services will require interoperability of three separate service elements: the wireless network, the landline LEC network, and the PSAP. Successful implementation of E911 access will require the finalization of interworking standards (many of which are in the earliest stages of development) and the deployment of